Claims

1.   A method of controlling a queue buffer (20), said queue
      buffer (20) being connected to a link (40) and being
      arranged to queue data units (30) of a flow in a queue
      (21), comprising

      determining (S1) a value of a length parameter (QL;
      QL_{av}) related to the length of said queue,

      comparing (S2) said value (QL; QL_{av}) with a length
      threshold value (L_{th}) and performing (S3) a congestion
      notification procedure if said value (QL; QL_{av}) is
      greater than said length threshold value (L_{th}), and

      an automatic threshold adaptation procedure (S6),

      characterized in that

      said automatic threshold adaptation procedure (S6)
      comprises a procedure for adjusting said length
      threshold value (L_{th}) on the basis of one or more flow
      control parameters (LIM1, LIM2; rwnd; rlfr).

2.   The method of claim 1, wherein said one or more flow
      control parameters (LIM1, LIM2) are predetermined
      values.

3.   The method of claim 2, wherein said predetermined values
      are associated with known flow control procedures for
      one or both of data unit senders and data unit
      receivers.

4.   The method of one of claims 1 to 3, furthermore
      comprising a procedure (S5) for determining one or more
      of said one or more flow control parameters (LIM1, LIM2;

rwnd; rlfr) from a flow control parameter (rwnd; rlfr)
introduced by one of a sender and a receiver of said
flow queued in said queue (21).

5.   The method of claim 4, wherein said flow control
      parameter is introduced by said receiver and inserted
      into acknowledgment data units sent from said receiver
      to said sender for acknowledging the correct receipt of
      data units.

6.   The method of claim 5, and said buffer being provided in
      a network node of a communication network connecting
      said sender and said receiver, wherein said procedure
      for determining said flow control parameter comprises
      extracting said flow control parameter from said
      acknowledgement data units at said network node.

7.   The method of claim 5 or 6, and said buffer being
      provided in a first network node of a communication
      network connecting said sender and said receiver,
      wherein said procedure for determining said flow control
      parameter comprises extracting said flow control
      parameter from said acknowledgement data units at a
      second network node different from said first network
      node and sending said flow control parameter from said
      second network node to said first network node.

8.   The method of one of claims 1 to 7, and a flow control
      performed for said flow in said queue (21) being window-
      based, wherein one of said one or more flow control
      parameters is a control window.

9.   The method of claim 8, wherein said control window is
      introduced by said receiver and expresses a limitation
      of how many data units the receiver can handle.

10. The method of claim 8, wherein said control window is
     introduced by said sender and expresses a limitation of
     how many data units the sender can send.

5   11. The method of one of claims 1 to 7, and a flow control
          performed for said flow in said queue (21) being rate-
          based, wherein one of said one or more flow control
          parameters is a control rate.

10   12. The method of claim 10, wherein said control rate is
          introduced by said receiver and expresses a data rate
          limitation for arriving data units that the receiver can
          handle.

15   13. The method of claim 10, wherein said control rate is
          introduced by said sender and expresses one of a data
          rate limitation for the rate of data units that the
          sender can send, a current sending rate and a target
          sending rate.

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     14. The method of one of claims 1 to 13, wherein said
          automatic threshold adaptation procedure comprises

          estimating a link capacity value (LC),

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          analyzing whether the performance of a congestion
          notification procedure will lead to an underutilization
          of said link due to a reaction of said sender to the
          congestion notification under the condition that said
30   length threshold value (L_{th}) is set equal to said
          estimated link capacity value (LC), and

          adapting said length threshold value (L_{th}) on the basis
          of a result of said analyzing step by setting said
35   length threshold value (L_{th}) equal to said estimated
          link capacity value (LC) if said analyzing step
          indicates no underutilization, and setting said length

threshold value (L_{th}) larger than said estimated link
capacity value (LC) otherwise.

15. The method of claim 14, wherein said length threshold
    value (L_{th}) is set to a value derived on the basis of
    one of said flow control parameters (LIM1, LIM2; rwnd;
    rlfr) if said analyzing step indicates underutilization.

16. The method of claim 14 or 15, and a sender of said flow
    in said queue (21) sending said data units in a
    predetermined sequence, a receiver of said flow in said
    queue (21) sending to said sender acknowledgment
    messages for acknowledging the correct receipt of said
    data units, where each acknowledgment message identifies
    the last data unit correctly received in said sequence,
    and said receiver sending to said sender a first window
    value expressing a limitation of how many data units the
    receiver can handle, a flow control performed by said
    sender being window-based using a send window, said send
    window being selected as the minimum of said first
    window value and a second window value, such that said
    sender must not send data units with a sequence number
    higher than the sum of the highest acknowledged sequence
    number and the send window, and said sender dividing
    said second window value by two as a reaction to a
    congestion notification, and thereafter increasing the
    second window by a predetermined increment for each
    duplicate acknowledgment message it receives,

    wherein

    one of said one or more flow control parameters (LIM1,
    LIM2; rwnd; rlfr) is said first window value and said
    length threshold value (L_{th}) is initially set equal to
    said estimated link capacity value (LC), and

said automatic threshold adaptation procedure comprises setting said length threshold value (L_{th}) equal to said estimated link capacity value (LC) if said first window value is greater than 1.5 times the sum of said estimated link capacity value (LC) and the momentary value of said length threshold value (Lth).

17. The method of claim 16, wherein said automatic threshold adaptation procedure comprises setting said length threshold value (L_{th}) equal to said estimated link capacity value (LC) if said first window value is greater or equal to 1.5 times the sum of said estimated link capacity value (LC) and the momentary value of said length threshold value (Lth).

18. The method of claim 16 or 17, wherein said length threshold value (L_{th}) is set equal to a function of said first window value if said first window value does not fulfil the condition for setting said length threshold value (L_{th}) equal to said estimated link capacity value (LC).

19. The method of claim 18, wherein said function is the difference between said first window value and a predetermined reduction value.

20. A computer program product comprising a computer program arranged to execute the method of one of claims 1 to 19 when executed on a programmable data processing device connected to a communication network containing said link.

21. A queue buffer controller (10) for controlling a queue buffer (20) that is connected to a link (40) and is arranged to queue data units (30) of a flow in a queue (21), comprising

a queue length determinator (101) for determining a
value of a length parameter (QL; QL_{av}) related to the
length of said queue,

5   a comparator (102) for comparing said value with a
length threshold value,

a congestion notifier (103) for performing a congestion
notification procedure if said value is greater than
10   said length threshold value, and

a threshold adaptor (104) for automatically adapting
said length threshold value,

15   characterized in that

said threshold adaptor (104) being arranged for
adjusting said length threshold value on the basis of
one or more flow control parameters (LIM1, LIM2; rwnd;
20   rlfr).

22.   The queue buffer controller (10) of claim 21, wherein
said one or more flow control parameters (LIM1, LIM2)
are predetermined values.

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23.   The queue buffer controller (10) of claim 22, wherein
said predetermined values are stored in said queue
buffer controller (10) and associated with known flow
control procedures for data unit receivers.

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24.   The queue buffer controller (10) of one of claims 19 to
21, further comprising a flow control parameter
determinator (105) for determining one or more of said
one or more flow control parameters (LIM1, LIM2; rwnd;
35   rlfr) from a flow control parameter (rwnd; rlfr)
introduced by one of a sender and a receiver of said
flow queued in said queue (21).

25. The queue buffer controller (10) of claim 24, wherein said flow control parameter is introduced by said receiver and inserted into acknowledgment data units sent from said receiver to said sender for acknowledging the correct receipt of data units, and said queue buffer (20) being provided in a network node of a communication network (3) connecting said sender and said receiver, wherein said flow control parameter determinator (105) is arranged for extracting said flow control parameter from said acknowledgement data units at said network node.

26. The queue buffer controller (10) of claim 21, wherein said flow control parameter is introduced by said receiver and inserted into acknowledgment data units sent from said receiver to said sender for acknowledging the correct receipt of data units, and wherein said queue buffer (20) is provided in a first network node of a communication network (3) connecting said sender and said receiver, wherein said flow control parameter determinator (105) is arranged for receiving said flow control parameter from a second network node at which said flow control parameter was extracted.

27. The queue buffer controller (10) of one of claims 21 to 26, wherein said threshold adaptor (104) comprises

an estimator for estimating a link capacity value (LC),

an analyzer for analyzing whether the performance of a congestion notification procedure will lead to an underutilization of said link due to a reaction of said sender to the congestion notification under the condition that said length threshold value is set equal to said estimated link capacity value (LC), and

28

an adaptor for adapting said length threshold value on
the basis of a result of said analyzing step by setting
said length threshold value equal to said estimated link
capacity value (LC) if said analyzing step indicates no
5   underutilization, and setting said length threshold
value larger than said estimated link capacity value
(LC) otherwise.

28.   The queue buffer controller (10) of claim 27, wherein
10   said threshold adaptor (104) is arranged to set said
length threshold value to a value derived on the basis
of one of said flow control parameters (LIM1, LIM2;
rwnd; rlfr) if said analyzer indicates underutilization.

15 29.   The queue buffer controller (10) of claim 27 or 28, a
sender of said flow in said queue sending said data
units in a predetermined sequence, a receiver of said
flow in said queue sending to said sender acknowledgment
messages for acknowledging the correct receipt of said
20   data units, where each acknowledgment message identifies
the last data unit correctly received in said sequence,
and said receiver sending to said sender a first window
value expressing a limitation of how many data units the
receiver can handle, a flow control performed by said
25   sender being window-based using a send window, said send
window being selected as the minimum of said first
window value and a second window value, such that said
sender must not send data units with a sequence number
higher than the sum of the highest acknowledged sequence
30   number and the send window, and said sender dividing
said second window value by two as a reaction to a
congestion notification, and thereafter increasing the
second window by a predetermined increment for each
duplicate acknowledgment message it receives,

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wherein

one of said one or more flow control parameters (LIM1,
LIM2; rwnd; rlfr) is said first window value and said
threshold adaptor (104) is arranged to initially set
said length threshold value equal to said estimated link
capacity value, and to set said length threshold value
equal to said estimated link capacity value if said
first window value is greater than 1.5 times the sum of
said estimated link capacity value (LC) and the
momentary value of said length threshold value (Lth).

30. The queue buffer controller (10) of claim 29, wherein
said threshold adaptor (104) is arranged for setting
said length threshold value equal to said estimated link
capacity value if said first window value is greater or
equal to 1.5 times the sum of said estimated link
capacity value (LC) and the momentary value of said
length threshold value (Lth).

31. The queue buffer controller (10) of claim 29 or 30,
wherein said threshold adaptor (104) is arranged to set
said length threshold value equal to a function of said
first window value if said first window value does not
fulfil the condition for setting said length threshold
value equal to said estimated link capacity value.

32. The queue buffer controller (10) of claim 31, wherein
said function is the difference between said first
window value and a predetermined reduction value.